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Michael Braito, Heidi Leonhardt, Marianne Penker, Elisabeth Schauppenlehner-Kloyber, Georg Thaler, Courtney G. Flint

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Tel +49 (30) 2093 46845, Email gabriele.wuerth@agrar.hu-berlin.de

Agricultural Land Markets – Efficiency and Regulation

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Abstract

While soil degradation is continuing to threaten the global agricultural production system, a common understanding of how to encourage sustainable soil management is missing. With this study, we aim to provide new insights on targeted policies that address the heterogeneity of farmers. We scrutinize the plurality of farmers' views on soil management among arable farmers in the Austrian (and European) policy context. To do so, we apply Q methodology, a method that identifies different perspectives on a topic present in a population and quantifies this subjectivity statistically. We interviewed 34 arable land farmers, who varied in their farming backgrounds. The results yielded four different viewpoints on soil management held by the interviewed farmers: two more ecocentric perspectives (Innovative Nature Participants, Pleasure Seekers) and two more anthropocentric perspectives (Traditional Producers, Profit Maximisers). Our study shows that farmers' soil management is influenced by more than economic considerations and that a mix of policy approaches is needed to reach all farmers and avoid adverse effects or ineffective strategies. We provide several suggestions for policymakers on how to complement agri-environmental schemes: appealing to human-nature relationships, offering training and experimentation services, fostering social networks, and raising the social reputation of farmers.

Keywords: farmers' viewpoints, soil management, Q methodology, farmer behavior, soil policies
JEL Codes: Q15, Q18

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* michael.braito@boku.ac.at, ORCID: 0000-0002-9763-0804,
Institute of Sustainable Economic Development, University of Natural Resources and Life Sciences Vienna, Feistmantelstrasse 4, 1180 Wien, AT

1 Introduction

Soil erosion and the loss of soil biodiversity and fertility threaten the global agricultural production system (Lal, 2015). Apart from natural processes that continually shape the state of soils, agricultural activities trigger soil degradation (Panagos et al., 2014). As soil management can not only degrade, but also restore soils (Lal, 2015), it is addressed in the 2030 Agenda for Sustainable Development by the United Nations (Tóth et al., 2018). However, a common strategy to encourage sustainable soil management is missing so far (Panagos et al., 2016), and the effectiveness of soil conservation policies is questionable (Kutter et al., 2011). A comparative analysis by Kutter et al. (2011) of hundreds of mandatory, voluntary incentive-based and awareness-increasing soil conservation policies across 24 EU countries revealed that most policies did not sustainably achieve their targeted environmental goals, but also that different policy mechanisms addressed similar soil conservation issues.

A small but growing body of literature (Frey and Jegen, 2001; Kieninger et al., 2018; Rode et al., 2015; Vatn, 2010) indicates that monetary incentives (the most common soil conservation policy) may not be enough to promote sustainable soil management practices substantially. Monetary incentives such as agri-environmental schemes (AES) do have the intended and primary effect of motivating behavioral change by offering financial rewards. However, they also have an often underestimated secondary effect of undermining intrinsic motivations for conservation or excluding individuals who do not feel addressed by the policy's framing (Baum and Gross, 2016; Dessart et al., 2019; Pannell et al., 2006). Therefore, long-term changes in soil management might be better promoted by other or supplementary measures, such as facilitating group learning (Prager and Creaney, 2017). This calls for behavioral insights into policymaking. Policymakers need to understand how farmers themselves perceive (their) soil management and how their mental models link with their management practices (Bartkowski and Bartke, 2018; Davies and Hodge, 2007). However, Dessart et al. (2019) identified several knowledge gaps regarding the interactions between soil management policies and how they can be orchestrated to meet the plurality of farmers' cognitive and normative mental models. According to the authors, this knowledge gap might explain why secondary policy effects, such as crowding-out or rebound effects, are not yet fully understood, particularly in the context of farming practices.

Baum and Gross (2016) address these secondary effects and show that policies for behavior change are effective only if they understand and consider both (1) individual behavioral determinants and (2) the context that frames those determinants, and ultimately the expression of a particular behavior. The authors suggest a governance approach that considers the complexity of farmers' daily soil management decisions and rightly appreciates the context of those whom the policy addresses (Knowler and Bradshaw, 2007; Prager and Posthumus, 2011).

Regarding individual behavioral determinants, many studies have collected and examined variables that might explain diverging soil management practices (for an overview, see Dessart et al., 2019). For example, a review of 23 publications on farmers' adoption of conservation measures identified more than 150 explanatory variables (Prager and Posthumus, 2011). All studies underscore that farming has many facets and is not just about running a business and

optimizing income (McElwee, 2004). Farming decisions are, like any other human behavior, guided by beliefs, attitudes, norms, or values (Hamdy and Aly, 2014; Karali et al., 2014; Knowler and Bradshaw, 2007; Mattison and Norris, 2005; Prager and Posthumus, 2011; Rajendran et al., 2016). Thus, farmers are anything but a homogenous group (Darnhofer et al., 2005), and better understanding their soil management a difficult endeavor.

Regarding the context that frames behavioral determinants and ultimately the expression of farmers' behavior, we need to acknowledge that farmers are embedded in their unique contexts, such as families, the society they live and work in, changing policies and legislations, developments of global markets or changing customer demands. Only a few studies investigate the adoption of soil conservation across contexts (Knowler and Bradshaw, 2007). As one of those few, Prager and Posthumus (2011) relate environmental, economic, institutional, and local variables to the adoption of soil conservation. More recently, Bartkowski and Bartke (2018) reviewed 87 European studies to identify leverage points for soil conservation policies and distinguish between farm and farmer characteristics, the social-institutional environment, economic constraints, and decision characteristics (e.g., the goodness of fit).

With this study, we aim to provide new insights for targeted policies for sustainable soil management. As discussed above, such policies should be geared to the heterogeneity of farmers but should also take the farmers' context into account. We thus first scrutinize farmers' views on soil management across different contexts, to understand the plurality of these viewpoints. More specifically, we are interested to see which different views on soil management we can distinguish among Austrian crop farmers. Based on these insights, we then develop policy recommendations that take this plurality into account. Thus, we aim with this study to support policy endeavors that strive to address and crowd-in farmers holding different views.

Empirically, *Farming Styles* identification and using *Q Methodology* to assess farmer perspectives are promising research approaches to deduce and distinguish farmers' viewpoints. Both methods allow being integrative in the sense of discerning the individual embedded in a broader context. *Farming Styles* differentiates groups of farmers that share a particular mindset (Ploeg, 1994; Schmitzberger et al., 2005). This approach has, among other things, helped to better understand variability in farmers' conservation practices (Schmitzberger et al., 2005). While farming style research is criticized for overly relying on the researchers' assessment, *Q Methodology* allows focusing on what people (in our case farmers) themselves select to be their approach to farm management (Fairweather and Klonsky, 2009). Therefore, *Q Methodology* has proven helpful in differentiating farmers' environmental perspectives (Davies and Hodge, 2007) and viewpoints on environmental behavior (Walder and Kantelhardt, 2018). As we aim to unravel farmers' soil management perspectives, we consider *Q Methodology* as well-suited to our research aim. The method combines qualitative and quantitative elements, which allows us to be comprehensive while still being able to reduce complexity. After identifying farmers' views on soil management, we discuss how soil conservation policies align with the identified viewpoints, and which types of policy may be promising options in the future.

In the remainder of the paper, we first explain *Q Methodology*. We summarize the existing research on soil conservation and variables influencing farmers' soil management, as such a thorough literature review constitutes the variable set of our Q study. We then describe our sample and data process of data collection. Afterward, we describe the results regarding the viewpoints we have found to exist among farmers. The discussion chapter then links our findings to policy. We close with a brief conclusion.

2 Material and Methods

Q Methodology offers the opportunity to explore subjectivity systematically (Brown, 1993) to identify distinct perspectives about the subject of research (Zabala and Pascual, 2016). It is an inherently exploratory and "qualiquantological" technique (Stenner and Stainton Rogers, 2004), which combines the advantages of qualitative (first-hand knowledge and personal insights) and quantitative (structured data, statistical analysis) research elements (Walder and Kantelhardt, 2018; Watts and Stenner, 2005). In practice, *Q Methodology* builds on an inverted factor analysis (Stephenson, 1936), where the result of the analysis is not a reduction of the explanatory variables, but rather a reduction of observed cases. Therefore, valid results can be drawn from a small sample of participants (Watts and Stenner, 2005).

Implementing *Q Methodology* combines three aspects: First, a *Q set* reveals the broader discourse of a given topic in society and literature. Developed by the researcher, the *Q set* (or Q sample) should provide a holistic or complete picture of the issue at hand (Watts and Stenner, 2005; Webler and Tuler, 2001). The *Q set* comprises a carefully selected subsample of heterogeneous statements, with each making a different assertion about the subject of research (Watts and Stenner, 2005), in our case soil management. Second, the *Q sort* reveals the participants' subjective viewpoints towards the research focus (Brown, 1993). During the sorting procedure, the research participants were asked to react on every single statement while taking into consideration the context of the broader *Q set* (Webler and Tuler, 2001). To do so, respondents ranked single statements in relation to all other statements in a *Q sort***.** Third, the *Q pattern analysis* reveals groups of participants that share the same viewpoints. By-person factor analysis and correlations between participants identify groups of participants who make sense of the pool of statements comparably and thus hold characteristic viewpoints (Stephenson, 1936; Watts and Stenner, 2005).

2.1 Q set

To compile our Q set, we first conducted a literature review on farmers' soil management and its determinants. Applying a semi-structured interview guideline, we then interviewed six expert stakeholders from public authorities (ministry of agriculture, agricultural county administration), extension services (chamber of agriculture), and an environmental NGO concerned with soil conservation. As a result of this first phase, we derived more than 100 statements that reflect the broader discourse of soil management internationally, and in Austria in particular.

In order to manage the large scale and complexity of the subject, we categorized the statements systematically (Brown, 1993; Watts and Stenner, 2005). We reviewed existing categorizations, and frameworks that proved to be helpful in previous studies. We found multiple variations in how to categorize influential variables of farmers' decision-making.

Among them, Bartkowski and Bartke (2018) grouped variables influential for farming in six groups in a review of 87 European studies: characteristics of the farm, characteristics of the farmer, behavioral characteristics of the farmer (e.g., attitudes), social-institutional environment, economic constraints, and decision characteristics (e.g., goodness of fit). In their individual-centered framework, Baum and Gross (2016, p. 55) distinguished between internal behavioral determinants and split contextual variables into three distinct levels: individual-level context, socio-cultural context, and techno-economic context. Dessart et al. (2019) organized behavioral determinants based on their 'distance' from the decision-making and distinguish between dispositional variables (e.g., personality, farming objectives, moral concerns), social variables (e.g., norms), and cognitive variables (e.g., knowledge).

Drawing from all these studies and adjusting them to our particular endeavor, we categorized our statements into the following four groups: farmer, farm, socio-cultural context, and natural context. Sorting across these categories ensured that our final Q set was comprehensive enough to portrait the real world as relates to farmers (Brown, 1993).

The first category, ***farmer***, includes statements related to the farmer's personal disposition and experience. This category acknowledges that farmers' behavior is ultimately the result of a complex and often subconscious decision-making process influenced by mental models and intrinsic motivations (Greiner and Gregg, 2011; Prager and Posthumus, 2011; Ryan et al., 2003). The second category, ***farm***, acknowledges that each farmer is influenced by characteristics of his/her farm, household characteristics (including economic considerations, potential farm successions, etc.), and nearby reference groups. The third category, ***socio-cultural context***, consists of influences that are exogenous of the farm and the farmer, and thus, not directly influenceable by the farmers themselves. These influences are designed and managed through public authorities or institutions, or that evolve from market dynamics and the socio-economic environment at large. The fourth category, ***natural context***, acknowledges that each farmer is embedded in a unique natural, non-human setting that forces them to tailor their farming practices accordingly. This includes that farmers may build a particular relationship with nature, which might translate to behavioral patterns, as suggested by Braito et al. (2017) and found to be a valuable concept for understanding farmers' behavior by Yoshida et al. (2018). We thus include several such types of human-nature relationships (HNR) in the Q set.

In the next step, we merged related statements and discarded duplicates and nonrelevant aspects, resulting in a manageable and robust set of 34 statements. The original statements were in German. Table 1 shows all 34 statements translated to English, including the categorization, the labels that we use henceforth to facilitate the text, and the sources from where we distilled the statements. Finally, we standardized the style and wording of the statements to reduce misinterpretation and ease the sorting for the respondents (Watts and Stenner, 2012). We pre-tested the *Q set* with several people familiar with farming in Austria to guarantee that the *Q set* delivered viable results and that no potential viewpoint was missing.

Table 1: List of statements allocated along the contextual layers

Contextual layer	#	Q statements	labels	Source/Literature
Farmer	1	Dealing with my soil ought to give me pleasure	***pleasure***	Stakeholder interviews
	2	When dealing with my soil my freedom as a farmer is my main concern	***freedom***	(Karali et al., 2014)
	3	I would deal with my soil differently if I had more time	***time availability***	(Dwyer et al., 2007)
	4	I attend training and extension services to learn more about soil use	***training***	(Arbuckle, 2012; Carlisle, 2016)
	5	Traditional, passed-down knowledge determines how I deal with my soil	***traditional knowledge***	(Karali et al., 2014)
	6	When dealing with my soil I rely on my own education and experience	***education***	(Arbuckle, 2012; Carlisle, 2016)
	7	When dealing with my soil I pay attention to my health	***health***	(Cranfield et al., 2010; Karali et al., 2014; Knowler and Bradshaw, 2007)
	8	I try new things when dealing with my soil	***openness to change***	(Knowler and Bradshaw, 2007; Prager and Posthumus, 2011; Reimer et al., 2014)
Farm	9	The profitability of my farm is top priority for me when dealing with my soil	***profitability***	(Barbayiannis et al., 2009; Boardman et al., 2003; Carlisle, 2016; Defrancesco et al., 2007; Dwyer et al., 2007; Lahmar, 2010; Robinson, 1999)
	10	The distance between a plot and my farm influences how I deal with my soil	***distance***	(Barbayiannis et al., 2009; Lahmar, 2010)
	11	The number of years that I will still farm a plot determines how I deal with my soil	***tenure security***	(Carlisle, 2016; Daloğlu et al., 2014; Karali et al., 2014; Leonhardt et al., 2019; Sklenicka et al., 2015)
	12	When dealing with my soil I avoid expensive investments	***avoid expensive investments***	(Carlisle, 2016)
	13	When dealing with my soil I want to avoid risks	***risk***	(Karali et al., 2014; Sattler and Nagel, 2010)
	14	When dealing with my soil I have a responsibility for employees and helping people	***responsibility for workers***	Stakeholder interviews
	15	When dealing with my soil I pay attention to the tidiness and neatness of my plots	***tidy plots***	(Ryan et al., 2003; Schneider et al., 2010; URBAN, 2005)
Socio-cultural context	16	When dealing with my soil I think about future generations	***future generations***	(Ryan et al., 2003)
	17	I coordinate with my neighbors when dealing with my soil	***coordinate with neighbors***	Stakeholder interviews
	18	How I deal with my soil ought not to have any negative impact on my neighborhood	***care for neighbors***	(Ryan et al., 2003)
	19	When dealing with my soil I go by the requirements and expectations of my customers	***customers' expectations***	(Karali et al., 2014)
	20	I implement expectations of society in how I deal with my soil	***society's expectations***	(Karali et al., 2014; Mills et al., 2017; Uthes and Matzdorf, 2013)
	21	My duty to provide food for society shapes how I deal with my soil	***food provision***	(Burton, 2004; Burton and Wilson, 2006)

Contextual layer	#	Q statements	labels	Source/Literature
	22	When dealing with my soil I avoid doing things that would make me the subject of gossip	***gossip***	(Karali et al., 2014)
	23	How I deal with my soil depends on agri-environmental schemes	***depend on AES***	(Batáry et al., 2015; Boardman et al., 2003; Hodge, 2001; Uthes and Matzdorf, 2013; Zechmeister et al., 2003)
	24	Voluntary programs and schemes are a useful guidance for how I deal with my soil, no matter whether I formally participate	***guided by AES***	(Pavlis et al., 2016; Wilson and Hart, 2001)
	25	Experiences of colleagues give me guidance for dealing with my soil	***others' knowledge***	(Coughenour, 2003; Falconer, 2000; Karali et al., 2014)
	26	How I deal with my soil is determined by laws and governmental regulations and sanctions	***laws & sanctions***	(Gorton et al., 2008; Karali et al., 2014; Posthumus and Morris, 2010; Prager and Posthumus, 2011)
Natural context	27	When dealing with my soil I take account of the natural conditions of the plot, such as soil quality, slope, etc.	***natural conditions***	(Bielders et al., 2003; Prager and Posthumus, 2011; Wilson and Hart, 2001)
	28	By dealing with my soil I avoid damages by natural influences (e.g., climate change, pests)	***natural influences***	(Mitter et al., 2018; OECD, 2014)
	29	The weather determines how I deal with my soil	***weather***	(Karali et al., 2014)
	30	When dealing with my soil I steer nature for my own use	***master***	(Braito et al., 2017)
	31	When dealing with my soil I work together with nature	***partner***	(Braito et al., 2017)
	32	When dealing with my soil I feel as a part of nature and its cycles	***participant***	(Braito et al., 2017)
	33	When dealing with my soil I have a responsibility for nature	***steward***	(Braito et al., 2017)
	34	When dealing with my soil I do not think about nature	***apathy***	(Braito et al., 2017)

2.2 Q sort

Q methodology does not require a large number of participants (Watts and Stenner, 2005), but the sample needs to ensure that all potential viewpoints are represented (Brown, 1980). For our research, we selected a sample of 34 arable land farmers in Austria, who varied in their farming backgrounds and thus potentially hold different perspectives on soil conservation. Farmers were contacted by different means, including contact established via extension agents and other stakeholders, an open call in a newsletter, and a call among students of agricultural economics. The participants (primary decision-makers of the farm) were, in most cases, interviewed on their farms by one of the co-authors during winter 2017/18. Most sorting procedures, including post-sorting interviews, lasted between 45 minutes and 2 hours.

Respondents were first asked to read all statements and create three piles (generally agree – indifferent/ do not know – generally disagree) concerning the central question "What influences your soil management?". This helped them to get a first impression of the range of available opinions (statements) and to ease the subsequent sorting procedure (Brown, 1993). Next, respondents rank-ordered the statements into a predefined sorting grid (Table 2), representing a quasi-normal distribution and thus symmetrical about the middle (Brown, 1993; Watts and Stenner, 2005). The ranking along the scale from -4 (*fully disagree*) to +4 (*fully agree*) dictates the number of statements the respondent can assign to each rank. During the sorting procedure, respondents were encouraged to ask questions or discuss thoughts (Watts and Stenner, 2012). Once respondents were finished and satisfied with their ranking, we conducted brief post-sorting interviews as recommended by Watts and Stenner (2005). This provided us with further insights regarding a) the respondents' interpretation of the statements, b) the respondents' motivations for ranking statements at the extremes (-4, +4), c) the comprehensiveness of the *Q set*, and d) general comments of the respondents.

Table 2: Forced choice distribution

	Most disagree								**Most agree**
Ranking value	-4	-3	-2	-1	0	+1	+2	+3	+4
Number of statements	(2)	(3)	(4)	(5)	(6)	(5)	(4)	(3)	(2)

2.3 Q pattern analysis

The final *Q sorts* were administered, photographed, and digitalized using the free software package PQMethod[1]. We excluded one participant from our analysis for not understanding the sorting instructions. In a first step, we correlated all *Q sorts* to reflect the relationship of each *Q sort* to every other *Q sort* (Watts and Stenner, 2005) and to identify the degree of similarity between any two *Q sorts* (ranging from -1 to +1) (Brown, 1993). Next, we factor-analyzed the correlation matrix applying a Principal Component Analysis (PCA) with a Varimax Rotation, in order to detect patterns among the *Q sorts* and to extract different viewpoints (Schmolck, 2002; Walder and Kantelhardt, 2018). In contrast to regular PCA, *Q Methodology* correlates respondents instead of variables in order to detect relationships between them. This results in a small number of sets of sorted statements, so-called factors. A factor is "the weighted average *Q sort* of a group of respondents that responded similarly" (Zabala and Pascual, 2016). The loadings of the initial *Q sorts* on these factors describe to which extent a participant corresponds – positively or negatively – with each viewpoint (Schmolck, 2002).

We only extracted factors if (a) their Eigenvalue was larger than 1, (b) they were defined by at least two Q sorts, and (c) if they reasonably reflected the real world (Watts and Stenner, 2005). As a result, we extracted four factors representing different viewpoints on soil management. In order to obtain the best result, we first 'flagged' associated factors and *Q sorts.*

[1] http://schmolck.org/qmethod/

Second, we raised the suggested significance threshold value for a *Q sort* from ± .50 (Brown, 1993) to ± .55 to assure a higher resemblance of the loading Q sorts to the respective factor array. And third, we excluded *Q sorts* from defining a factor if their factor loadings for a second factor was higher than the calculated significance level of the study[2] (at $p < .01$). The software-defined Varimax rotation accounted for a total explained variance of 67%, with 18 uniquely and significantly loading *Q sorts*. To increase the amount of loading *Q sorts*, we rotated the results modestly by hand and were able to increase the loading *Q sorts* to 23 by keeping the total explained variance constant at 67%.

The final result of a Q Methodological study is a set of narrative descriptions of the viewpoints that exist among the participants. These descriptions are based on a qualitative interpretation of the quantitative results (e.g., the factors) and of the transcribed post-sorting interviews.

3 Results

Table 3 shows the factor loadings of all Q sorts (farmers) for the four extracted factors. The correlation scores indicate that factors were less distinct than expected. We considered alternative solutions with fewer factors, but settled for the four-factor solution, as it provides valuable insights into the nuances that separate viewpoints, which might at first glance appear similar. Moreover, we account for the high correlations based on our narrow subject of investigation as well as the by-hand rotation. However, we make use of the commonalities and analyze the statements that all factors view similarly.

[2] For $p < .01$: 2.58* (1/√number of items in the Q set) = .44 for our study.

Table 3: *Q sorts* (farmers) factor loadings
(bold scores indicate that the Q sort defines the factor)

Q sort	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**
1	0.41	0.38	**0.55**	0.08
2	0.37	0.34	**0.68**	-0.09
3	0.20	0.13	**0.68**	-0.01
4	0.42	-0.02	0.23	**0.59**
5	**0.64**	0.35	0.24	0.38
6	0.29	0.31	**0.59**	0.35
7	**0.73**	-0.23	0.26	0.20
8	**0.72**	0.21	0.43	-0.05
9	**0.71**	0.33	0.27	0.21
10	0.39	0.11	0.54	0.55
11	0.44	**0.63**	0.25	0.22
12	0.51	0.03	0.61	0.21
13	0.24	-0.01	0.38	**0.75**
14	0.11	0.09	**0.76**	0.24
15	0.63	0.46	0.41	0.27
16	**0.72**	0.15	0.22	0.18
17	0.26	0.54	0.21	0.54
18	0.01	**0.87**	0.17	0.06
19	0.42	0.31	0.40	0.54
20	**0.58**	0.29	0.22	0.43
21	**0.75**	0.17	0.24	0.22
22	0.55	0.07	0.48	0.00
23	0.25	0.57	0.26	0.54
24	0.58	0.47	0.22	0.30
25	**0.61**	0.14	0.17	0.18
26	0.50	0.31	0.25	0.48
27	0.31	0.45	0.47	0.35
28	**0.71**	0.07	0.13	0.29
29	**0.66**	0.44	0.11	0.29
30	**0.62**	0.42	0.15	0.32
31	0.34	0.39	0.06	**0.73**
32	**0.67**	0.14	0.32	0.34
33	0.06	-0.01	**0.66**	0.27
Number of defining *Q sorts*	12	2	6	3
Explained variance in %	26	12	16	13
Eigenvalue	8.91	3.96	5.28	4.29
Correlation between factor scores				
Factor 1		0.42	0.64	0.68
Factor 2			0.46	0.35
Factor 3				0.54

Table 4 describes the characteristics of the whole sample and each factor. Respondents were, on average, 46.6 years old and had an average of 26 years of farming experience. The average farm in our sample covered 101 ha. Thirty interviewed persons (91 %) were male farmers; three were women. The majority of the surveyed farmers completed vocational education (55 %). Twenty-seven farms (82 %) were run full-time. Fourteen farmers grew field crops (42 %) exclusively, while the other 19 farmers (58 %) ran mixed farming systems. Nine interviewees (27 %) were organic farmers.

Table 4: Respondents' characteristics

	full sample	**F1**	**F2**	**F3**	**F4**
Number of farmers	33	12	2	6	3
Age [mean] (min-max)	46.6 (24-69)	46.4	30.5	47.5	53
Experience as a farmer [mean years] (min-max)	16.3 (0-43)	17	3.5	18.5	23
Farm size arable land [mean ha] (min-max)	100.8 (6-800)	88	122.5	96.3	15
Gender (male)	30 (91%)	11	2	6	2
Level of education					
Vocational	15 (45%)	5	2	3	2
Secondary	11 (33%)	4		3	
University	3 (9%)				1
Other/unknown	4 (12%)	3			
Full-time farmers	27 (82%)	10	2	5	3
Type of farming					
Field crops only	14 (42%)	5	1	2	1
Mixed farms	19 (58%)	7	1	4	2
Of which:					
Cow (dairy)	6 (18%)	4	-	1	-
Cow (fattening)	2 (6%)	-	-	-	1
Pig	10 (30%)	3	1	3	1
Poultry	1 (3%)	-	-	-	-
Organic farming	9 (27%)	3	1	-	2
Direct Marketing	11 (33%)	4	-	2	3

Table 5 describes each factor as a hypothetical Q sort and lists each statement with its respective rank it would have on the Q distribution. Particularly interesting are statements ranked at the two extremes (±4 and ±3), but also those that are ranked higher or lower than by any other factor. Additionally, Table 5 shows distinguishing statements that are differentiating the respective factor from the other factors, and consensus statements, which are statements that are similar across all factors.

Table 5: List of statements and factor scores

		Statements[b]	Factor scores[a]			
			F_1	F_2	F_3	F_4
Farmer	1	pleasure	2	2	1	4
	2	freedom	-2	3	-1	2
	3	time availability	-3	-4	-4	**1**
	4	training	2	3	2	**-1**
	5	traditional knowledge	-1	**3**	-1	0
	6	education	1	0	3	2
	7	*health*	*0*	*0*	*0*	*1*
	8	openness to change	1	0	0	0
Farm	9	profitability	-1	1	**4**	0
	10	distance	-1	-1	-3	-2
	11	*tenure security*	*-2*	*-3*	*-2*	*-2*
	12	avoid expensive investments	-3	-4	-1	0
	13	risk	-1	0	1	-1
	14	responsibility for workers	0	**2**	-3	-1
	15	tidy plots	**-1**	4	2	1
Socio-cultural context	16	future generations	3	1	2	2
	17	coordinate with neighbors	-3	-2	-4	-4
	18	care for neighbors	1	-2	1	1
	19	customers' expectations	0	2	-2	-1
	20	society's expectations	0	0	-2	-1
	21	food provision	1	**3**	0	**-2**
	22	gossip	-4	-2	-3	-3
	23	depend on AES	-2	-2	0	-2
	24	guided by AES	0	-1	-1	-3
	25	others' knowledge	0	**-3**	-1	0
	26	laws & sanctions	-2	-3	**0**	-4
Natural context	*27*	*natural conditions*	*2*	*1*	*3*	*2*
	28	natural influences	2	0	1	0
	29	weather	4	1	4	3
	30	master	1	**-2**	1	1
	31	partner	3	2	2	4
	32	participant	4	-1	0	3
	33	steward	3	0	3	2
	34	apathy	-4	-1	-2	-3

[a] Distinguishing statements ($p < .01$) are marked in bold
[b] Consensus statements ($p > .01$) are given in italics

In the following characterizations of the viewpoints held by those in each factor, the numbers in parentheses refer to the statements and their respective position in the hypothetical Q sorts (Table 5). Interviewees are quoted using their internal ID (P 1 – 33).

3.1 Innovative Nature Participants (Factor 1)

The first factor identifies those farmers whose view on soil management is influenced by their relationship with nature and their keenness to improve their soil management. We thus label them *'Innovative Nature Participants'*. Compared to the other viewpoints, *Innovative Nature Participants* care least about their freedom as farmers (2: -2). Instead, they care more than

others about societal expectations of how soil should be managed (20: 0), and less about their reputation, such as gossip (22: -4) or the appearance of their plots (15: -1).

These farmers work together with nature (31: +3), see themselves as part of nature (32: +4), feel responsibility for nature (33: +3), and they firmly reject willful ignorance of nature (34: -4). Consequently, this is reflected by their stewardship for future generations (16: +3), as illustrated by one farmer who explains that *"[soil and] farm are only borrowed from future generations"* (P 16). In contrast, profitability is comparatively unimportant for this viewpoint (9: -1), as *"profitability results automatically anyway [from proper soil management]"* (P 29). The focus on nature of *Innovative Nature Participants* is underlined by the fact that weather is one of the most critical determinants of their soil management (29: +4), as are the natural conditions of a plot (27: +2). Therefore, proper soil management can even help to mitigate damages by natural influences such as climate change or pests (28: +2).

Farmers sharing this viewpoint try new things (8: +1) or make investments, even if expensive or risky (12: -3; 13: -1). Consequently, learning from experts is seen as valuable (4: +2), as are experiences of colleagues (25: 0). To improve their soil management, *Innovative Nature Participants* rely less on traditional knowledge than others (5: -1). They are indifferent about AES being useful guidance (24: 0), which they do not see as something that determines their soil management (23: -2).

3.2 Traditional Providers (F2)

The second factor consists of farmers whose view on soil management is defined by productivism together with a concern for socio-cultural expectations, which is why we label them *'Traditional Providers'.* Literally all nature-related statements are ranked lower by this factor than by any other (30: -2; 31: +2; 32: -1; 33: 0; 34: -1). Correspondingly, the natural conditions of a plot (27: +1), as well as weather (29: +1), are of little importance to their soil management practices. What matters is to provide food for society (21: +3), as *"the provision of food is something beautiful for every farmer"* (P 11). To do so, *Traditional Providers* do not shy away from expensive investments (12: -4) and do not see themselves as time-constrained in their optimal soil management (3: -4).

Social norms and values, however, are more influential to this perspective than to any other: customers' expectations (19: +2) and a responsibility towards employees (14: +2), but not the coordination with neighbors (17: -2). This translates to farmers' care of having tidy and neat plots (15: +4), so that *"[a plot] is also attractive for the eye"* (P 18), and they reject less than others that they avoid doing things that would cause gossip (22: -2). In line with that, this viewpoint is least influenced by tenure security (11: -3). One interviewee underlines the strong personal norms that characterize this viewpoint, stating that treating all lands equally, irrespective of its tenure status, is "*somewhat a little code of honor"* (P 11).

Compared to other viewpoints, *Traditional Providers* rely strongly on traditional and passed-on knowledge (5: +3) as well as training by professionals (4: +3). In comparison, their education (6: 0) and experiences of colleagues (25: -3) play minor roles. For this viewpoint, their freedom as farmers is of great importance (2: +3). Correspondingly, AES (23: -2) or laws (26: -3) are not of much concern.

3.3 Profit Maximisers (F3)

The third factor consists of farmers whose view on soil management is business-oriented, legitimating the label *'Profit Maximizers'*. Indeed, economic viability as a driver for soil management is ranked highest by this viewpoint (9: +4). One interviewee brought it to the point: *"the soil is important for profitability […] [and] without profitability, you are gone"* (P 33). Like *Innovative Nature Participants*, farmers with this mindset also regard natural factors and nature as highly important for soil management. In particular, biophysical conditions of a plot and the weather are significant determinants for their soil management (27: +3; 29: +4;). Concerning farmers' relationship with nature (HNR), *Profit Maximizers* agree most with having responsibility for nature (33: +3), but they do, to a lesser degree, understand themselves as collaborating with nature as much as with others (31: +2) as they feel least as part of nature (32: 0).

Profit Maximizers are not much influenced by social norms, derived from customers (19: -2), colleagues (25: -1), or society (20: -2), or values such as responsibility for employees (14: -3). One interviewee even commented on the statement of societal expectations (31) with *"they all have no idea – unfortunately"* (P 14). Likewise, coordination with neighbors is not considered necessary at all (17: -4). In line with that, passed-on knowledge (5: -1) is less important than their education or habitual soil management (6: +3). *Profit Maximizers* are more risk-averse than others (13: +1) and place less value on the pleasure derived from soil management than others (1: +1).

In contrast to the other factors, *Profit Maximizers* do not disagree that laws and sanctions (26: 0) or agri-environmental schemes (23: 0) influence their soil management. They do not see why time (3: -4) or the distance between a plot and the farmhouse (10: -3) should influence their soil management. Thus, farmers who belong to this group seem to know how to cope with difficult circumstances, in order to maximize their profit from their soil.

3.4 Pleasure Seekers (F4)

The fourth factor consists of farmers whose view on soil management is similarly driven by environmental aspects as *Innovative Nature Participants*, but who are distinctive in their self-reliance and focus on freedom and pleasure. Consequently, we label them *'Pleasure Seekers'*. Farmers with this viewpoint agree strongly that their HNRs are influential to their soil management, such as working together with nature (31: +4) and feeling like a part of nature (32: +3). A second prominent determinant of their soil management is the search for pleasure (1: +4). Correspondingly, farmers with this viewpoint place more importance on their health than other factors (7: +1).

In a similar vein, *Pleasure Seekers* value their freedom (2: +2) and do not see their soil management as influenced by laws and governmental sanctions (26: -4) or dependent on AES (23: -2). Coordination with neighbors is also a non-issue (17: -4), as is potential gossip (22: -3). Consequently, this viewpoint sees their own education and experiences (6: +2) as essential for soil management and seeks less training and education by professionals (4: -1). This might be related to the fact that that these farmers appear the only ones that feel time-constrained (3: +1).

Moreover, in comparison to the others, this viewpoint is more cautious about making expensive investments (12: 0). According to one interviewee, *"they [other farmers] have to invest over and over again […] the investment is not even repaid, and they have to do the next one. They are stuck in a rat race"* (P 4). This again emphasizes striving for freedom, here from a financial perspective. *Pleasure Seekers* disagree that the provision of food gives meaning to farming and soil management (21: -2).

4 Discussion

The aims of this study were twofold: (a) to gain a deeper understanding of farmers' viewpoints related to their soil management in order to (b) provide behavioral insights to policymaking. By applying Q methodology with Austrian arable farmers, we identified four different viewpoints related to their soil management.

Although the four viewpoints are distinct and differ in fundamental aspects, we found some considerable parallels. The most apparent similarity across all viewpoints is that farmers align their soil management to the biophysical environment of their plots and – all except the *Traditional Providers* – place great importance on weather conditions. This is hardly surprising, as farmers are, after all, working closely in and with their natural and biophysical environment (Bielders et al., 2003; Prager and Posthumus, 2011; Tanentzap et al., 2015). Moreover, and confirming Leonhardt et al. (2019), farmers across all viewpoints do not care how long they will continue to farm a plot. Accordingly, farmers do not consider plots that they may have to give up or cease to farm in the future as any different in their soil management. Less obvious, our results reveal that farmers state to be quite resistant to social pressures such as gossip across different viewpoints, except the *Traditional Providers*. Also, less anticipated, our study shows that monetary policy instruments such as AES have, according to the interviewees little influence on farmers' soil management. Although partly discussed in the literature (Gowdy, 2008; Howley et al., 2015), it raises questions about the effectiveness of such monetary policy instruments.

4.1 Ecocentric versus anthropocentric viewpoints on soil management

Apart from the similarities mentioned above, the analysis of the Q sets identified four different mindsets regarding soil management. Some farmers have a close connection with nature and align their soil management with nature's needs and thus can be considered to share an **ecocentric viewpoint** (*Innovative Nature Participants*, *Pleasure Seekers*). Others have a more distant relationship with nature and rather align their soil management with their own needs and goals of producing food or generating an economic profit, and therefore share an **anthropocentric viewpoint** (*Traditional Produces*, *Profit Maximisers*).

The mindset of ***Innovative Nature Participants*** resembles the *Environmental Stewards* described by Brodt, Klonsky and Tourte (2006) and is comparable to the *Environmentalists* (Davies and Hodge, 2007), or the *Diversity-Maintaining* viewpoint (Walder and Kantelhardt, 2018). We label this viewpoint "innovative", as we found that the respective farmers are keen to improve their soil management, even if investments are expensive or risky. They have a close relationship with nature, care for it, and acknowledge it as a resource that needs to be conserved for future generations (Ryan et al., 2003). Important for policymakers, *Innovative*

Nature Participants are the only ones that see AES as a knowledge source, no matter whether they apply the suggested measure or not. This confirms that such a "secondary" effect of policy instruments, as observed by Wilson and Hart (2001), exists.

Pleasure Seekers share a combination of environmental and self-centered attributes. Quite distinctly, farmers with this mindset manage their soil for personal enjoyment and pleasure. They value their freedom as farmers and consequently do not adapt their soil management to laws, governmental sanctions, or AES. This viewpoint is not commonly described in the literature. However, it shares some aspects of the *Idealist* farming type (Schmitzberger et al., 2005). *Pleasure Seekers* rely strongly on their own experiences. It is, therefore, perhaps not surprising that they not only reject training and extension services as a source of soil management knowledge but are also resistant to external influences such as AES, apart from customers' expectations. Moreover, farmers with this mindset care little about societal expectations, do not coordinate much with neighbors and do not care about gossip. According to previous studies, these observations might be related to these farmers' age (Atari et al., 2009; Burton, 2014; Siebert et al., 2006). Being the oldest farmers in our sample and thus having the most experience might lower their willingness to change their farming style. Regarding farmers' disregard of society, Mills et al. (2017) suggest that this might be related to public discussions, which often tend to accuse agriculture of unsustainable practices, painting a negative picture of farmers. They are the only ones that would manage their soil differently if they had extra time. Lack of time might be related to these farmers' business approach: In contrast to the other three viewpoints, all farmers in our sample that share the *Pleasure Seekers* viewpoint are direct-marketers running a small family farm business, and thus, orient themselves to customers' expectations. As a result, they have to cope with the entire value chain of a product while having little labor support (Dwyer et al., 2007).

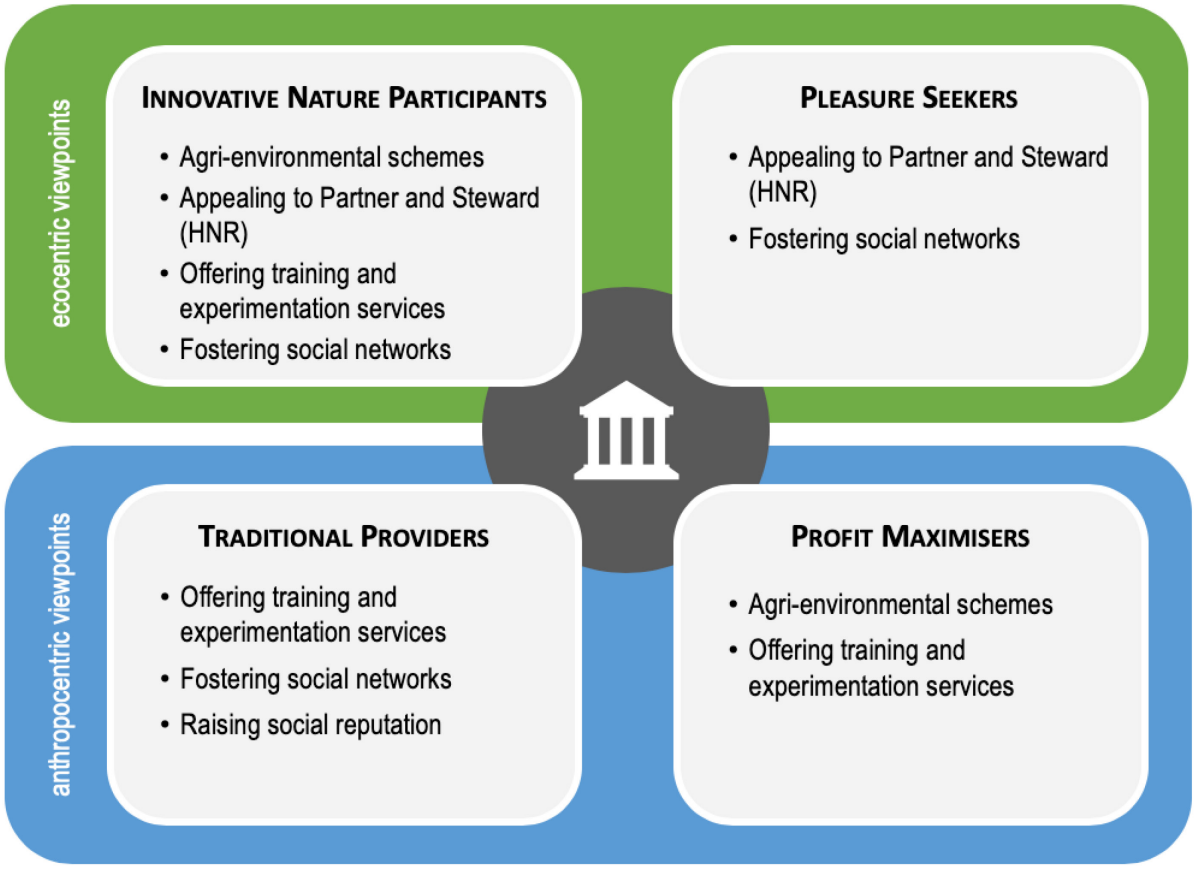
In contrast to the two ecocentric viewpoints, the ***Traditional Providers*** appear to be least connected to nature. Farmers with this mindset share strong traits of tradition, a focus on productivity, and are the least concerned about soil conservation. Other studies discuss similar viewpoints, such as *Production Maximisers* (O'Rourke et al., 2012) or *Yield Optimizers* (Schmitzberger et al., 2005), all of which put production above nature conservation. Socio-demographical aspects reveal that *Traditional Providers* in our sample are young, least experienced, and operate the largest farms. It thus seems reasonable for them to place agribusiness ideals (Burton and Wilson, 2006) over environmental ideals, as the latter often requires more effort. Social norms strongly influence these farmers' soil management, which might reflect their young age – they still have to prove their aptitude for farming by signaling that they adhere to some farming ideal. Thus, these farmers strive to live up to what is perceived by many as a 'good' farmer: they aim to have aesthetically well-maintained plots, which is believed to communicate land-use skills (Burton, 2004), and they understand themselves as important actors who provide food for society. Therefore, *Traditional Providers* might be more attracted by practices they consider as aesthetically pleasing or relevant for 'agricultural productivism' (Burton, 2004; Carlisle, 2016). Moreover, *Traditional Providers* are open to acquiring new soil management practices. They take passed on knowledge as a starting point, or as Carlisle (2016) formulates, they rely on it as the first-hand experience but are willing to learn more through training and extension services.

Among all four viewpoints, the ***Profit Maximisers*** have the most definite focus on their farms' profitability. This viewpoint resembles the *Commodity Conservationists*, identified among arable farmers in the UK (Davies and Hodge, 2007). Farmers with this mindset care for environmental conservation but do so by focusing on economic considerations in their soil management. They appear to be the only ones in our sample who consider policies and regulations as relevant for their soil management. This supports the argument of Pavlis et al. (2016) that economic motivations and income benefits are the primary motive for (some) farmers to participate in AES. However, it could also mean that these business-oriented farmers come closer to conflict with legal minimum requirements, which is why they consider the legal standards more critical than other farmers. *Profit Maximisers* consider nature, but also with a view to their farm's profit and their soil's functionality. Therefore, farmers with this mindset are most straightforward to reach with policies that address both attributes of the *Profit Maximisers*: focus on economic considerations and an inclination toward soil conservation.

4.2 Policy implications

In the following and based on our results, we derive policy recommendations that reflect an inclusive governance perspective. Figure 1 relates five policy categories to the four viewpoints on soil management. Accordingly, if the goal is to address all mindsets, policymakers should implement a combination of more than one policy category.

Figure 1: Policy categories aligned with the four mindsets



4.2.1 Agri-environmental schemes

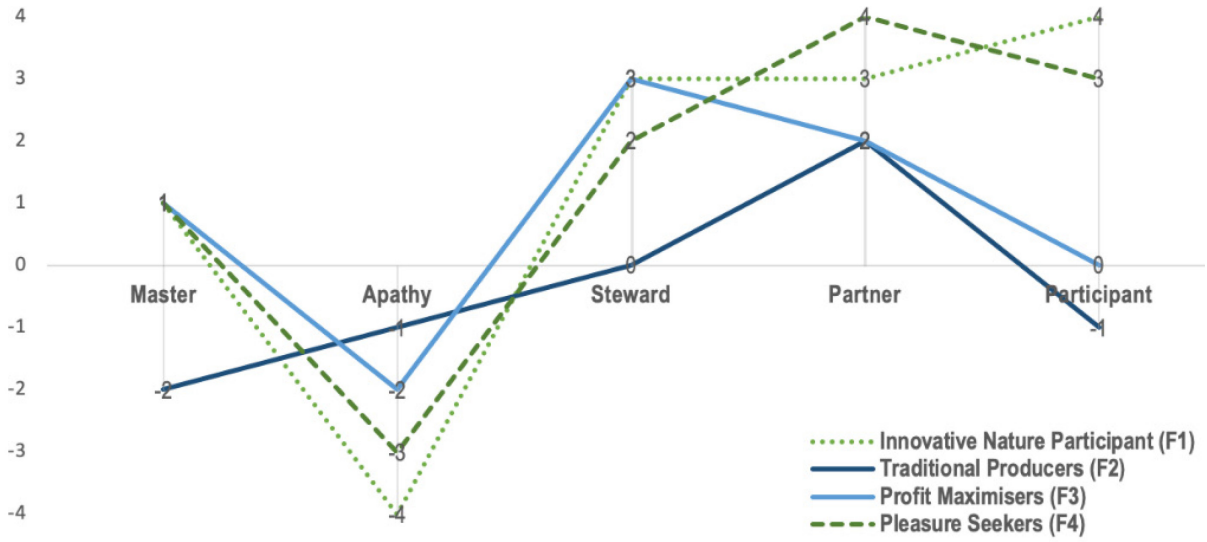
We examined two potential effects of AES, and find evidence that both only apply to a limited extent. First, AES can have a direct behavioral effect for *Profit Maximisers* and an indirect behavioral effect through knowledge transfer for *Innovative Nature Participants*. However, farmers of the two other groups do not see AES as an essential factor for their soil management. The literature is, however, ambiguous - while some question the long-term effect of AES in shifting farmers' attitudes towards more "green thinking" (Karali et al., 2014), others have found evidence that AES can induce attitudinal changes across participating farmers (Mason and Holmes, 2015). Whatever the effect might be, some farmers mentioned in the interviews that they started to recognize the value of policy-induced soil management practices after implementing it. Thus, the participation in AES induced a shift towards more environmentally friendly attitudes for some. Nevertheless, we suggest reducing the dominate role of AES in agricultural policy strategies by complementing them with the following policy instruments.

4.2.2 Appealing to Partner and Steward (HNR)

Our study indicates that farmers' relationship with nature is an essential behavioral determinant of soil management. Therefore, we recommend considering HNR in framing relevant policy strategies. However, individuals hold multiple HNR, which are context-sensitive (Flint et al., 2013) when translated into behavioral patterns in and for the natural environment (Braito et al., 2017). Similar to Yoshida et al. (2018), we find that the majority of farmers agree with the rather ecocentric HNR concepts such as the *Partner*, the *Steward*, and, although more ambiguous, to the *Participant* (see Figure 2). In contrast to previous studies, we find the HNR concept of the *Master* not rejected by most of our interviewed farmers. So far, most empirical HNR studies were less clear about the presence of this HNR (Braito et al., 2017; de Groot et al., 2011) or to a lower extent (Yoshida et al., 2018), although its theoretical foundation suggests its presence (Muhar and Böck, 2017).

Framing policies in terms of HNR is a complicated endeavor, as policies with unilateral framings, such as addressing only one HNR type, run the risk of excluding other HNR orientations. Nevertheless, framing in terms of HNR still appeals to this domain, while a purely business-oriented framing will not appeal to farmers' relationship to nature at all. Thus, our study indicates that appealing to the benefits particular practices have for nature and farmers' relationship with nature can be a promising avenue for policymaking. Examples for this could be awareness-raising campaigns that appeal, e.g., to the role humans and farmers have as partners or stewards of nature.

Figure 2: (Dis-)agreement with HNRs among the four viewpoints on soil management



4.2.3 Offering training and experimentation services

Another insight from this study is that training services are likely a promising way of encouraging farmers' soil conservation behavior. Except for the *Pleasure Seekers*, farmers are willing to expand their knowledge and adopt different information channels. Passed-on knowledge about soil management serves in some cases as a starting point, while for others, it is their previous education and experience. Almost all farmers are keen to expand their knowledge on soil management through training, whether for the sake of nature or for improving their economic benefits. Thus, extension services are natural instruments to spread innovative and sustainable soil management practices, and could, for instance, be complemented by voluntary on farm-experiments, where farmers share hands-on knowledge. Given that AES requires applicants to attend training courses anyway (BMLFUW, 2017), training services for those farmers not participating in AES would be beneficial.

4.2.4 Fostering social networks

Previous research has stressed the importance of social networks for the adoption of soil conservation practices (Coughenour, 2003) and has highlighted the importance of early adopters for the diffusion of practices in a region (Morton and McGuire, 2011; NWF (National Wildlife Federation), 2012). Targetti et al. (2019), for instance, acknowledge social networks as a catalyst for efficient adoption of environmental-friendly practices. In our study, while the *Traditional Providers* take their customers and employees into account, other viewpoints disagree that these stakeholders influence their soil management. All viewpoints share a rejection of coordination with neighbors, except when it comes to avoiding adverse impacts. And while the appearance of plots to others matters somewhat to some groups of farmers, judgment in the form of gossip is considered irrelevant by most viewpoints. Regarding farming communities, the experiences of colleagues are considered somewhat irrelevant by two viewpoints, and the *Innovative Nature Participants* and *Pleasure Seekers* are indifferent. However, to address these two groups, it may be helpful to use social networks, as they may be difficult to reach otherwise. Moreover, *Innovative Nature Participants* play a unique role as

early adopters of new technologies and soil management practices who can share their knowledge. Relevant policies worth mentioning include organized settings for group learning such as regular meetings on soil erosion as currently organized by extension services, or study groups of interested farmers, supervised and supported by local extension agents.

4.2.5 Raising social reputation

With regards to meeting expectations of society in their soil management, the farmers of our study largely responded as unwilling or indifferent. Several farmers commented on this statement that they feel like *"society often has absolutely no idea what we farmers do*" (P 7), or that "*society expects so much and has no idea*" (P 14). Others shared that they feel like farming has a wrongly negative reputation. Both are reasons for not caring about society's expectations. Thus, there appears to be a divide and lack of understanding between farmers and society that prevents farmers from taking society's interests into account. However, previous research has shown that norms have the potential to actively inform farmers' pro-environmental behavior (Fang et al., 2018; Mills et al., 2017). Raising farmers' social reputation, enabling communication between both sides, and thus closing the observed cleavage between some farmers and broad society might then help to make such society-averse farmers again reachable through social norms. Furthermore, as some farmers were found to undertake pro-environmental land-use practices because they felt obligated to do so, as it contributes positively to their societal image (Mills et al., 2017), this approach might also appeal to farmers with pro-societal norms.

5 Conclusions

With this study, we aimed to identify farmers' viewpoints on their soil management. Ultimately, this helped us to derive applicable policy recommendations that consider the plurality of farmers' motivations across contexts. We unraveled the pluralism of farmers' viewpoints on soil management among Austrian arable farmers in the Austrian (and European) policy context by applying Q Methodology. We adapted existing and helpful categorizations and frameworks and derived our own operationalization of the vast number of behavioral determinants that influence farmers' soil management.

Our study shows that farmers are a very diverse group, and they mostly do not act as model 'homo economicus' in the sense of profit maximisers when managing their soil. Instead, they consider nature and society next to – and sometimes over – outputs and income, and they differ in their preferences and priorities. We have identified some of these preferences that are shared by groups of farmers, such as stewardship for nature, or personal pleasure and freedom.

We identified four distinct viewpoints on soil management among Austrian farmers, two of which can be considered more ecocentric, while the other two tend to be more anthropocentric. Using these different viewpoints or mindsets as a starting point, we then related five different policy strategies to these groups. We suggest that a mix of policy approaches is necessary to reach all farmers and avoid adverse effects or ineffective strategies.

Due to the nature of Q methodology, we cannot draw any conclusions concerning the prevalence of these viewpoints in the general farmer population, and neither can we provide suggestions on how to identify these groups based on demographics. Since these are questions of interest, a follow-up quantitative study would be of great use for future policymakers, extension agents, or NGO personnel. Nevertheless, we have made a first step in characterizing Austrian crop farmers and identifying the range of viewpoints, such that future research and soil policies can build upon our foundation.

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